Remarks/Arguments

Amendments

On November 29, 2007, the undersigned conducted an interview with examiner Kelly Stouffer discussing the examiner's rejection of July 30, 2007. A summary of interview is as follows:

The undersigned brought it to the examiner's attention that the new reference, Jurgensen 2003/0054099 A1, sublimates the non-polymeric compound by exposing it to a carrier gas. The undersigned directed the examiner's attention on this point to paragraphs 33-35 and 57-58 of Jurgensen 2003/0054099 A1. In contrast, the applicant transforms the non-polymeric compound into the gas phase by flash evaporating it with a carrier liquid. The undersigned then explained that by using a carrier gas to volatilize the non-polymeric compound, the Jurgensen technique creates a rate limitation because the solubility of a molecule in a gas is limited and therefore the rate of deposition is limited.

In contrast, the applicant uses a liquid carrier to transport a solution or particles of the non-polymeric compound into the vacuum chamber. The undersigned pointed out that there is no practical limit on how fast you can move a liquid through a tube, so it is distinguished from the prior art because it is capable of very high deposition rates. The undersigned asked if the examiner was confused because once in the evaporation box, everything does get turned into a gas mixture, but pointed out that there is no meaningful carrier at that point and the throw distance (the distance between the point at which the non-polymeric compound is volatilized and the point at which is deposited on the substrate) is a fraction of an inch.

The examiner then suggested that the Lyons reference provided the non-polymeric compound in a liquid mixture. The undersigned then directed the examiner's attention to column 2, lines 10-20, wherein Lyons clearly states that vaporization occurs because of contact with a carrier gas, the same mechanism as Jurgensen 2003/0054099 A1. The examiner then suggested that the Lyons reference provided the non-polymeric compound in a liquid mixture was volatilized in some other fashion in the examples given in column 6 of Lyons. The undersigned directed the examiner's attention to lines 22-25 of column 6, where Lyons makes it clear that vaporization occurs because of contact with a carrier gas.

Finally, the examiner suggested that despite the fact that Lyons and Jurgensen 2003/0054099 A1 both teach that vaporization occurs because of contact with a carrier gas, the pending claims could still not be distinguished from the prior art because the applicant's language at claim 1, steps b and c:

> b. pumping said mixture to the interior of a heated evaporation box, c. exposing said mixture to a temperature within said heated evaporation box sufficient to convert substantially all of said non-polymeric compound and fluid carrier to a gaseous form, ...

does not preclude the possibility that the non-polymeric compound could be heated by a carrier gas and thereby converted to a gaseous form. The examiner suggested that the applicant incorporate more restrictive language to preclude this possibility.

The undersigned suggested changing the language of claim 1, steps b and c such that it was clear that the temperature to which the mixture was exposed was provided by the evaporation box itself, as opposed to a carrier gas, as follows:

> b. pumping said mixture to the interior of a heated evaporation box, c. exposing said mixture to a temperature ~~within~~ generated by said heated evaporation box sufficient to convert substantially all of said non-polymeric compound and fluid carrier to a gaseous form, ...

While no agreement was reached that such a change would overcome the prior rejection, the examiner did agree to look at such a change if presented in a written form, which the applicant has now provided with this amendment. The examiner further agreed that such an amendment would not constitute new matter requiring a new search. Finally, the examiner agreed that if the examiner were to reject the claim as written above, that the examiner would suggest a further limitation that would render the claim allowable, if the examiner thought of one.

Accordingly, the applicant has amended the claims in the manner discussed by the examiner and the undersigned. No new matter is added thereby. The undersigned respectfully requests that the examiner remove her rejection of claims 1- 25 under 35 USC 103(a).

35 USC 103(a)

The examiner has rejected all claims under 35 USC 103(a) as being unpatentable over Lyons in combination with Jurgensen 2003/0054099 A1 and a variety of other references. As previously explained, the key difference between the Lyons reference, the Jurgensen 2003/0054099 A1 reference, and the claimed invention is the fact that Lyons and Jurgensen 2003/0054099 A1 both rely on a "carrier gas" to vaporize and transport the material that will form the thin film coatings in Lyons' deposition method. In Lyons, the "carrier gas" is heated before it is brought into contact with the coating material, such that the "carrier gas" acts to evaporate the coating material. As stated by Lyons, at column 2, lines 12-15:

> "The droplets are contacted with the carrier gas, which causes the droplets to vaporize even at temperatures well below the boiling point of the droplets."

Accordingly, the mechanism by which Lyons transforms the thin film coating material (which Lyons describes as "droplets") into a gas form and transports the material to the substrate is entirely distinct from the present invention. In Lyons, the thin film coating material is "gasified" by the interaction of the thin film coating material with the high temperature gas carrier. Jurgensen 2003/0054099 A1, the non-polymeric compound is sublimated and carried to the substrate by exposing it to a carrier gas. Jurgensen 2003/0054099 A1 makes this point explicitly at paragraphs 33-35 and 57-58.

In contradistinction, the "fluid carrier" of the present invention does NOT cause the thin film coating material to gasify, and does NOT utilize the carrier gas to transport the material to the substrate. Rather, the present invention utilizes a "heated evaporation box" to gasify the material, whereupon it is in the immediate vicinity of the substrate, and thus does not have to be "transported" to the substrate to form the coating. The distinction is critical because it involves not only different physical processes for generating the thin film coating material used to form the deposition, but also different equipment. Further, this distinction also dramatically impacts the throughput of the two systems. The present invention is capable of much higher deposition rates because the thin film coating material can be loaded onto the liquid carrier at near saturation levels. In contrast, since Lyons and Jurgensen 2003/0054099 A1 are using the carrier gas to gasify the thin film coating material and transport it to the substrate, Lyons and Jurgensen 2003/0054099 A1 will experience much lower percentages of both gasifying the thin film coating material in the Lyons and Jurgensen 2003/0054099 A1 and loading it into the carrier gas, and subsequently much slower rates of deposition. Accordingly, by using a different mechanism than Lyons and Jurgensen 2003/0054099 A1, the present invention achieves much higher throughput rates.

Lyons clearly indicates that it is the carrier gas 24, and not chamber 17, that supplies the energy to vaporize the materials that will be deposited as a thin film. A column 12 line 66 through column 13 line 4, Lyons states:

> "For example, because the thermal energy for vaporization comes from carrier gas 24, higher gas temperatures may be needed and/or desirable in order to supply in a thermal energy to vaporize some liquids, particularly at higher flow rates of the liquids." (Emphasis added)

Lyons focus on the carrier gas as the critical element for providing the energy necessary for vaporization, and not chamber 17, is clearly indicated a column 12, lines 36-38 where Lyons states:

> "Chamber 17 is not necessary, but helps convey vapor to substrate 16 more efficiently and also helps to shape geometry of vapor 30 to enhance coating performance."

Jurgensen 2003/0054099 A1 also makes it clear that the carrier gas is responsible for sublimation and transport of the material. Jurgensen does so in claim 1, and also at paragraph 35, where Jurgensen states:

> [0035] Transport of the sublimated starting material to the reactor is assisted by means of a gas flow. This gas is also used to set a precursor concentration in the feed line.

In contrast, in the present invention there is no carrier gas, because no such transport is required, as the materials that are deposited on the substrate are volatilized in the immediate vicinity of the substrate, using the energy of the heated evaporation box (as opposed to the energy from the carrier gas). In the present invention as currently claimed, the non-polymeric compound is mixed with a liquid carrier, and the mixture is heated not by the carrier gas, but by the evaporation chamber:

> 1) (Presently Amended) A method for coating a thin film of a non-polymeric compound on a substrate comprising the steps of: a. providing a mixture of said non-polymeric compound and a liquid carrier, b. pumping said mixture to the interior of a heated evaporation box, c. exposing said mixture to a temperature ~~within~~ generated by said heated evaporation box sufficient to convert substantially all of said non-polymeric compound and liquid carrier to a gaseous form, d. removing said non-polymeric compound and liquid carrier in said gaseous form through an exit slit in said evaporation box, and e. condensing said

non-polymeric compound on a substrate maintained in a vacuum and in motion relative to said exit slit in said evaporation box.

Lyons and Jurgensen 2003/0054099 A1 have no liquid carrier, and instead use a carrier gas. In the present invention, the liquid carrier and the non-polymeric compound are both vaporized together by the external energy provided by a heated evaporation box. Lyons and Jurgensen 2003/0054099 A1 also have no heated evaporation box. Instead, Lyons has an optional chamber, which may be heated, but is not used to vaporize the non-polymeric compound. Lyons uses thermal energy from the carrier gas to vaporize the non-polymeric compound. In paragraph [0028] Jurgensen explicitly points out that the "sublimation device for the starting materials is geometrically separated from the reactor." Thus, the present invention and the method taught by Lyons and Jurgensen 2003/0054099 A1 differ in the equipment, the physical steps, and the mechanisms that are used to carry out the respective methods. Accordingly, the applicant respectfully requests that the examiner remove her rejection of claims 1,7-9-18, and 23-25 under 35 USC 103(a).

The key difference between the majority of the remaining references and the claimed invention is the fact that all of these references are describing some varient of chemical vapor deposition techniques (CVD). In CVD techniques, a chemical reaction takes place that binds the deposited material to the substrate. No such chemical reaction occurs in the present invention. Rather, as set forth in claims 1 and 19, (and all remaining claims by virtue of dependency), the non-polymeric compound is condensed on the substrate. Condensation is not a chemical reaction. The examiner will readily appreciate that condensation is an entirely different mechanism than the chemical reactions that occur in CVD techniques.

For example, the examiner has rejected claims 2-4 under 35 USC 103(a) as being unpatentable over Lyons and Jurgensen 2003/0054099 A1 in view of US patent number 5393564 to Westmoreland. The examiner concedes that Lyons "does not include the substrate with a temperature being sufficiently low enough to condense the fluid composition on the substrate then raising the temperature to cause the solvent to evaporate," and then asserts that Westmoreland provide such a teaching in column 3, line 27-43 and column 1, line 50-55. The examiner's attention is therefore drawn to column 3, lines 37-38, where Westmoreland states:

> "So that the precursor reacts immediately with the reacting gas, which is either injected into the chamber or form during evaporation of the solution, to deposit a film."

Clearly, Westmoreland is using chemical reactions to form the thin film, as would be expected in chemical vapor deposition techniques. Accordingly, Westmoreland adds nothing to the Lyons reference with respect to the present invention, which uses an entirely separate mechanism from chemical vapor deposition and does not utilize reactions to form a thin film. The applicant respectfully requests that the examiner remove her rejection of claims 2-4 under 35 USC 103(a).

The examiner has further rejected claim 5 under 35 USC 103(a) as being unpatentable over Lyons and Jurgensen 2003/0054099 A1 in view of US patent number 6258171 to Agarwal. At the outset, the applicant notes that Agarwal also teaches an improvement to chemical vapor deposition techniques. The examiner concedes that Lyons "does not include the excess solvent vapor recovered, recycled and directed back into the evaporation box," and then asserts that Agarwal provide such a teaching in column 6, line 6-16. The examiner's attention is therefore drawn to the first sentence of the background section, and the first sentence of the summary of the invention, where Agarwal states:

> " This invention relates to a direct liquid injection system which provides for on-line cleaning, and more particularly to a system and process for the controlled deposition of metal oxide layers using chemical vapor deposition techniques."

and

> "The present invention meets that need by providing a direct liquid injection system which has on-line cleaning of the vaporizers without the need for shutting down the CVD process, and thus eliminating down time."

Clearly, as with Westmoreland, Agarwal is using chemical reactions to form the thin film, as would be expected in chemical vapor deposition techniques. Accordingly, Agarwal adds nothing to the Lyons reference with respect to the present invention, which uses an entirely separate mechanism from chemical vapor deposition and does not utilize reactions to form a thin film. The applicant respectfully requests that the examiner remove her rejection of claim 5 under 35 USC 103(a).

The examiner has further rejected claim 6 under 35 USC 103(a) as being unpatentable over Lyons and Jurgensen 2003/0054099 A1 in view of US patent number 6258171 to Agarwal, and further in view of US patent number 541260 to Veersteg. As with Westmoreland and Agarwall, Veersteg also teaches an improvement to chemical vapor deposition techniques. The examiner concedes that Lyons and Agarwal "do not include a method for capturing the left over evaporated fluid carrier with a cold trap in front of a pump," and then asserts that Veersteg provides such a teaching at column 3, line 60-64 and in figure 1. The examiner's attention is therefore drawn to the first sentence of the background section, and the first sentence of the summary of the invention, where Veersteg states:

> "The present invention relates to a method and apparatus for chemical vapor deposition (CVD) of thin films on a semiconductor substrate which uses an ultrasonic nozzle based liquid delivery system for liquid precursor solution injection."
>
> and
>
> "The present invention seeks to overcome the drawbacks of prior CVD techniques by providing a liquid delivery system for a CVD apparatus in which liquid precursor solution is injected directly with one or more ultrasonic atomizing nozzles into a CVD reactor chamber."

Clearly, as with Westmoreland and Agarwal, Veersteg is using CVD techniques, which inherently utilize chemical reactions to form the thin film. Accordingly, Veersteg adds nothing to the Lyons and Agarwal references with respect to the present invention, which uses an entirely separate mechanism from chemical vapor deposition and does not utilize reactions to form a thin film. The applicant respectfully requests that the examiner remove her rejection of claim 6 under 35 USC 103(a).

Finally, the examiner has further rejected claims 19-22 under 35 USC 103(a) as being unpatentable over Lyons and Jurgensen 2003/0054099 A1 in view of Westmoreland, and further in view of Jagannathan. The examiner concedes that Lyons and Westmoreland "do not include the metal as metal (8- hydroxyquinoline) chelate and the solvent as 1-hexanol," and then asserts that Jagannathan provide such a teaching in paragraph 0135, lines 1-6. The examiner's attention is therefore again drawn to paragraph 0008 of the Jagannathan specification, where Jagannathan states:

> "It is therefore an object of the present invention to provide a method of depositing a functional layer of material on the substrate using compressed fluids such as compressed gases, liquids or supercritical fluids."

In the remainder of the specification, Jagannathan details how the rapid decompression of "compressed fluids" is used to deposit a functional layer of material onto a substrate. Accordingly, as with Lyons and Westmoreland, the Jagannathan reference teaches an entirely different mechanism than the present invention for depositing materials on the substrate. As with Lyons and Westmoreland, Jagannathan does not utilize a heated evaporation box to form a materials into a vapor. As previously discussed, Lyons does so with a hot carrier gas and Westmoreland does so using chemical vapor deposition techniques. Jagannathan does so with rapid decompression. Accordingly, Jagannathan adds nothing to the Lyons reference or to the Westmoreland reference with respect to the present invention, which uses an entirely separate mechanism to form the vapor that is deposited as a thin film and which does not utilize the mechanism of Lyons, Westmoreland or Jagannathan. The applicant respectfully requests that the examiner remove her rejection of claim 10 under 35 USC 103(a).

Closure

Applicant has made an earnest attempt to place the above referenced application in condition for allowance and action toward that end is respectfully requested. If the not allowed, the applicant respectfully requests that the amendments to the claims set forth herein nevertheless be entered into the record. Should the Examiner have any further observations or comments, she is invited to contact the undersigned for resolution.

Respectfully submitted,

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The undersigned hereby certifies that the forgoing Amendment dated November 29, 2007 in reply to the office action of July 30, 2007 together with a fee sheet and a return postcard are being deposited with the United States Postal Service as First Class Mail, postage prepaid, in an envelope addressed to

Mail Stop Non-Fee Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

on the date set forth below.

Douglas E. McKinley, Jr.
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Nov 29, 2007
Date